FIELD OPERATIONS PLAN

Site Inspection of the Longshot Mine and Mill
Colville National Forest, Washington — June 2005

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1.0 INTRODUCTION

Millennium Science and Engineering, Inc. (MSE) has been contracted by the USDA Forest Service to perform a Site Inspection (SI) of the Longshot Mine and Mill on the Colville National Forest. This Field Operations Plan (FOP) is a streamlined document that combines elements of a Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP). A site–specific Health and Safety Plan (HASP) also is included as Appendix A and field forms are provided as Attachment A. The FOP provides a detailed description of the SI field investigation activities and is intended for use by field personnel during the field investigation. The FOP also discusses the laboratory analytical procedures and quality assurance/quality control (QA/QC) methods to be employed both in the field and the lab to ensure data quality. The SI will be performed in accordance with U.S. Environmental Protection Agency (EPA) guidelines and state and federal regulations.

1.1 PURPOSE AND OBJECTIVES

The SI is a component of the Superfund Accelerated Cleanup Model, devised by EPA to meet the requirements of the Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA). The Longshot SI is intended to provide sufficient and appropriate information for: (1) assessing potential risks to human health and the environment, and (2) developing and evaluating potential removal action alternatives. The primary objectives of the Longshot SI are to:

- Determine if a release has occurred;
- Quantify the volume and extent of an existing or potential release;
- Evaluate existing or potential impacts to terrestrial and aquatic habitats;
- Evaluate existing or potential risk to human and ecological receptors and establish appropriate risk-based, site-specific, clean up levels; and
- Determine 90 percent Upper Confidence Level (UCL_{90}) on soil background concentrations.

2.0 SITE DESCRIPTION AND BACKGROUND

The Longshot Mine is an inactive lead-zinc mine and mill located about 13 miles northeast of Colville, Washington. The site is located in eastern half of Section 18, Township 36 North, Range 41 East of the Willamette Meridian (Figure 1). Site features include:

- Remnants of a mill and other structures
- Two open adits and one open stope
- Ponds
- An ore bin
- Waste rock piles
- A series of small tailings impoundments

The site is located near the top of a small drainage and ranges in elevation from 3,480 to 3,640 feet. The site is adjacent to an unnamed ephemeral tributary to South Fork Mill Creek. Tailings were placed in the ephemeral drainage in a series of small tailings impoundments. The impoundments are relatively thin and widespread and according to Forest Service personnel, there is a small pond in the last impoundment. The tailings are vegetated, intermixed with soil, and not well defined in some areas. According to Forest Service personnel, the total estimated volume of tailings is approximately 1,000 cubic yards (cy).

There is a single ore bin full of unprocessed ore at the mill site and waste rock is piled along the access road to the site. In addition to the mill, there are a few small structures and miscellaneous debris scattered on site. According to Forest Service personnel, the total estimated volume of waste rock at the site is approximately 2,000 cy. Other than mine wastes, there are no other suspected hazardous materials at the site.

Water flows from the lower adit at approximately 5 gallons per minute (gpm) and through a small pond just outside the adit. The discharge then flows along the road and into another pond, before eventually crossing the road, and flowing along the mill into the ephemeral tributary. It is unknown whether the adit flows year-round.

An Abbreviated Preliminary Assessment (APA) of the site was completed by the Forest Service in September 2003 (Forest Service 2003). Two soil samples were collected, one from an ore bin at the mill and one from a tailings impoundment, and analyzed for metals using an X-ray fluorescence (XRF) meter. Lead was the only metal detected at concentrations exceeding EPA Region IX Industrial Soil Preliminary Remediation Goals (PRGs) (EPA 2004). However, the detection limit for some metals may have been greater than the PRG resulting in false negatives. Based on the observed lead concentrations, the APA recommended an SI be completed.

3.0 FIELD INVESTIGATION ACTIVITIES

Field investigation activities will include: (1) a site reconnaissance to identify, inventory, and document the location and condition of waste sources and physical hazards; (2) physically measuring waste piles to estimate material quantities; (3) collecting mine waste, background soil, surface water, pore water, sediment, and benthic macroinvertebrate samples; and (4) completing a limited land survey of the site. The following sections describe the field investigation activities.

3.1 Collection of Non-sampling Data

Field staff will inspect the site and inventory mine-related features, including structures and physical hazards, adits, stopes, waste rock piles, tailings impoundments, ponds, and other potential hazards or sources of contamination. The perimeter of each waste rock pile and tailings impoundment will be staked or flagged to assist the land surveyor and to guide mine waste sampling. An XRF meter will be provided by the Forest Service to screen for metals and assist in delineating the mine waste areas. The XRF will be used according to the manufacturer's instructions. In general, a soil area is prepared and leveled and the XRF window is placed directly on the soil; the metals concentrations are acquired within 30 to 120 seconds. Each XRF location will be flagged and the global positioning system (GPS) coordinates recorded using a resource-grade GPS instrument. Results of the XRF analysis will be documented on an XRF Screening Record (Attachment A).

The dimensions of each waste rock pile and tailings impoundment will be measured to estimate material quantities. A portable hand auger will be used to measure the depth of tailings at multiple points in each tailings impoundment. The depth of material and approximate slope and dimensions of each impoundment will be recorded. In addition, the likelihood of the waste being in a "floodplain" will be evaluated (utilizing primarily visual evidence such as high water mark, existing erosion features, apparent land slope and topography, etc.). The volume of waste rock will be estimated by measuring and recording the physical dimensions of each waste rock dump and visually estimating the overall depth. The dimensions of each waste pile and a description of the physical waste characteristics will be documented in the Field Logbook.

Key site features and physical hazards will be photographed and the GPS coordinates will be recorded. Site features and weather conditions during the field investigation will be documented in the Field Logbook.

3.2 Sample Collection

Samples of mine waste, background soil, surface water, sediment, pore water, and benthic macroinvertebrates will be collected from the approximate locations shown on the conceptual site map in Figure 2, and summarized in Table 1. Mine waste characterization samples will be collected from the tailings impoundments, waste rock piles, and ore bin. Surface water and sediment samples will be collected from adit discharge, ponds, ephemeral tributary, and South Fork Mill Creek. Pore water and benthic macroinvertebrate samples will be collected from South Fork Mill Creek. Background soil samples will be collected from undisturbed areas around the site. If additional waste sources or potential pathways, such as seeps or springs, are identified during the field investigation, the Forest Service will be informed and additional samples will be collected, if warranted. All sample locations will be flagged, photographed, and the GPS coordinates will be recorded. The sampling methods and procedures are described in Section 4.1

3.3 Site Mapping

A local surveying contractor will be procured from Colville to perform a limited land survey of the site. A two-man crew will survey the site for up to 4 days during the field investigation. The objectives will be to collect sufficient topographic data points to: (1) generate a 2-foot contour map of the site, (2) delineate waste areas, (3) assist in estimating mine waste quantities, and (4) identify key site features and hazards. The survey will not include locating or surveying property boundaries. If an established benchmark cannot be located on site, a temporary benchmark will be established using a GPS instrument. If the vegetation density impedes collecting sufficient data to develop a site topographic map, surveying efforts will be focused on the mine waste piles and locating key site features and physical hazards.

3.4 Documentation

All field investigation activities will be documented in a bound waterproof Field Logbook using indelible ink. Field observations, measurements, and photograph descriptions will be recorded in the Logbook. The Logbook will also record when, where, and how all samples were collected, along with pertinent observations. The Logbook will also be used to document daily time on the site, field crew members, visitors to the site, and weather conditions. A Daily Field Summary, Attachment A, also will be used to summarize daily field activities, weather conditions, and significant issues.

All collected samples and field parameters will be recorded on the appropriate Sample Collection Record (Attachment A). Chain-of-custody (COC) documentation will be used to document and track sample possession as discussed in Section 4.2.3.

4.0 SAMPLING AND ANALYSIS PLAN

This section describes the sampling methods and procedures for each media; sample management activities such as sample identification, preservation, and shipping; laboratory analysis; decontamination procedures; and investigation derived waste.

4.1 Sampling Methods and Procedures

The sampling approach and methods are described in the following subsections by media type.

4.1.1 Mine Waste

Mine waste samples will be collected from the tailing impoundments, waste rock piles, and ore bin. If other potential waste sources are discovered during the field investigation, additional samples will be collected in consultation with the Forest Service. It is anticipated that waste sources at the site will be relatively shallow (less than 10 feet thick). One grab sample will be collected from each discrete waste rock pile and tailings impoundment and four composite samples will be collected at the discretion of field staff. Two grab samples will also be collected from the ore bin. The samples will be collected from depths ranging from 6 to 12 inches below ground surface (bgs) and consist of approximately 500 milliliters (mL) of material. Composite samples will each consist of a minimum of four subsamples. The composite samples will be homogenized by combining approximately 125 mL of soil from each subsample in a 1-gallon plastic bag and thoroughly mixing. All samples will be collected using disposable, single-use, plastic or wooden hand trowels.

The samples will be placed in laboratory supplied, 500-mL, wide-mouth plastic bottles, labeled, and packaged as described in Section 4.2. The samples will be submitted for the analyses summarized in Table 1. The general waste characteristics will be documented at time of sample collection and the sample location will be flagged and GPS coordinates recorded. Each sample will be documented on a Mine Waste Sample Collection Record (Attachment A).

4.1.2 Background Soil

Background soil samples will be collected from five areas near the mine that do not appear to have been disturbed by mining or other activities. The selected areas should be representative of background conditions for the site. One grab sample will be collected from each location at a depth of 6 to 12 inches utilizing disposable, single-use hand trowels. Each sample shall consist of approximately 500 mL of material. One composite sample also will be collected and shall consist of approximately 100 mL from each of the five grab sample locations. The subsamples will be combined in a 1-gallon plastic bag and thoroughly homogenized.

The samples will be placed in laboratory supplied, 500-mL, wide-mouth plastic bottles, labeled, and packaged as described in Section 4.2. The samples will be submitted for the analyses summarized in Table 1. The general soil characteristics will be documented at time of sample collection and the sample location will be flagged and GPS coordinates recorded. Each sample will be documented on a Background Soil Sample Collection Record (Attachment A).

4.1.3 Surface Water

Surface water sampling will include collecting grab samples, measuring stream flows, and measuring field parameters. Surface water samples will be collected from the adit discharge, ponds, ephemeral tributary stream, and South Fork Mill Creek. If any seeps, springs, or other tributary streams are discovered on the site, additional samples will be collected in consultation with the Forest Service. Stream samples will be collected from the following locations: upstream of the site; immediately downstream of the confluence with the adit discharge; immediately downstream of the site; immediately before entering South Fork Mill Creek, and South Fork Mill Creek upstream and downstream of the confluence with the tributary. If there is no flow in the ephemeral tributary upstream of the site, the field crew will attempt to locate an alternative background surface water source within the same drainage and as near the site as possible. All stream sampling will proceed from downstream to upstream locations to avoid cross contamination. A sample of the adit discharge will be collected at the mouth of the adit, before the first pond. Individual grab samples also will be collected from each pond.

The water samples will be collected from each source by submerging a laboratory supplied, 500-mL, wide-mouth, plastic bottle directly into the water with the opening pointed slightly upward toward into the current and allowing the container to fill. Leave sufficient headspace to allow for sample preservative. Care will be taken to prevent disturbing the sediment and organic material during sample collection. If the source is too shallow to collect a sample in this manner, disposal Tygon tubing and a peristaltic pump will be used to extract a sample. The tubing will be routed through the pump, one end of the tubing will be placed in the water source, and one end will be placed directly into a sample container. The pump speed will be regulated to avoid disturbing sediment or organic matter. New tubing will be used for each sample.

Samples requiring dissolved analyses will be filtered in the field using disposable Tygon tubing, a peristaltic pump, and a disposable 0.45-micron filter. An unfiltered sample will first be collected as described above. The unfiltered sample will then be pumped though a new disposable filter into a clean sample container. A new filter and new tubing will be used for each sample.

The appropriate preservative (Table 2) will be added to the sample and the container will be tightly capped. The samples will be labeled and packaged as described in Section 4.2, and submitted for the analysis summarized in Table 1. The sample location will be flagged and GPS coordinates recorded.

The field parameters summarized in Table 1 will be measured during sample collection and recorded on the Water Sample Collection Record (Attachment A). The field parameters include pH, temperature, dissolved oxygen (DO), conductivity (EC) and oxidation-reduction potential (ORP). A multi-parameter water quality meter will be used to measure the field parameters by collecting a water sample in a decontaminated 500-mL beaker and submerging the sensor in the sample. The instrument will be calibrated and operated per the manufacturer's specifications. All field calibrations, measurements, and notations will be recorded in the Field Logbook.

The flow at the adit discharge and each stream sampling location will be measured using a portable flume or timed volumetric method. The cross-sectional area of the channel and velocities will also be measured. It is anticipated that all applicable area streams will be wadable during sampling. The sample ID, flow, and field parameters will be documented on a Water Sample Collection Record (Attachment A).

4.1.4 Pore Water

The pore water sampling will be focused on South Fork Mill Creek rather than the ephemeral tributary because of the lack of scientific reference data for benthic communities in ephemeral stream habitats and the absence of viable fish habitat. Therefore, a total of two pore water samples will be collected from South Fork Mill Creek. The samples will be collocated with the surface water sample locations upstream and downstream of the confluence with the ephemeral tributary.

The pore water samples will be collected from the pore space in stream gravels in pool habitats where the substrate exceeds 6 inches depth. The samples will be collected using a 27-inch stainless-steel sampler (MHE Products PP-27) in accordance with the manufacturer's Operation Manual and Applications Guide (Attachment B). The sampler will be inserted to a minimum depth of 6 inches and a pore water sample will be extracted using a syringe and Tygon tubing or peristaltic pump at a flow rate of 50 to 200 milliliters per minute (mL/min). The pore water sample will be transferred from the syringe directly into a laboratory supplied, 500-mL plastic bottle. Leave sufficient headspace to allow for sample preservative. New syringes and tubing will be used at each sample location and the sampler will be decontaminated as described in Section 4.4.

The appropriate preservative (Table 2) will be added to the sample and the container will be tightly capped. The samples will be labeled and packaged as described in Section 4.2, and submitted for the analysis summarized in Table 1. The sample location will be flagged and GPS coordinates recorded.

Field parameters will be measured during sample collection by collecting a water sample in a decontaminated 500-mL beaker and submerging the sensor in the sample. Field parameters will include pH, temperature, DO, EC, and ORP. The sample ID, sample collection depth, and field parameters will be documented on a Water Sample Collection Record (Attachment A).

4.1.5 Sediment

Sediment samples will be collocated with the surface water sample locations and collected from the following locations: ponds, adit discharge, upstream of the site, immediately downstream of confluence with the adit discharge, downstream of the site, immediately before entering South Fork Mill Creek, and South Fork Mill Creek upstream and downstream of the confluence with the tributary. The stream sediment samples will be composite samples consisting of two 250-mL subsamples, one from pool and one from riffle habitat, at each stream sample location. The stream sediment samples will be collected from 0 to 2 inches below the streambed using disposable, single-use hand trowels, or disposable push samplers. Composite samples also will be collected from each pond and the adit discharge. The composite samples will consist of a minimum of three 200-mL subsamples. The sediment samples will be collected from 0 to 6 inches below the bottom surface using disposable, single-use hand trowels, or disposable push samplers.

The composite samples will be homogenized by combining the subsamples in a 1-gallon plastic bag and thoroughly mixing. Gravel and organic media will be removed and the samples will be placed in laboratory supplied, 500-mL, wide-mouth plastic bottles. Any water in the sample will be decanted so that the bottle is filled with as much sediment as possible. The bottles will be labeled and packaged as described in Section 4.2. The samples will be submitted for the analyses summarized in Table 1. The lab will be instructed to screen the sediment samples and discard material greater than 2 millimeters in diameter to focus the analysis on the finer material. If the sample location is not collocated with a surface water sample location, the location will be flagged and GPS coordinates recorded. The sample will be documented on a Sediment Sample Collection Record (Attachment A).

4.1.6 Aquatic Survey and Benthic Macroinvertebrates

An aquatic survey will be conducted to evaluate the potential impacts to the stream habitat, benthic macroinvertebrate community, and fish species. Each of these components of the aquatic survey may be affected by historical practices or current conditions of the site through physical impacts or chemical contamination. Because of the very limited scientific reference data for ephemeral stream habitats, the aquatic survey will focus on South Fork Mill Creek. Two stream reaches, each approximately 100 meters in length, will be established on South Fork Mill Creek immediately upstream and downstream of the confluence with the ephemeral tributary.

An aquatic habitat survey will be conducted for each reach following the protocols outlined in the *U.S. EPA Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers* (Barbour *et.al* 1999) and *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams* (Plotnikoff and Wiseman 2001). The aquatic habitat surveys will consist of collecting quantitative as well as qualitative data on water chemistry and physical habitat. The presence of fish will be documented by visual observations during the aquatic habitat survey.

MSE will collect quantitative and qualitative data on water chemistry and physical habitat. Data collected on water chemistry will include temperature, EC, DO, pH, and turbidity. Temperature, EC, DO, and pH will be measured in the field using a multi-parameter meter. Turbidity will also be measured in the field using a pocket turbidimeter. Habitat ratings will be completed for each reach using the *U.S EPA Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers*- Habitat Assessment Field Data Sheets (Barbor *et.al*. 1999).

Macroinvertebrate samples will be collected from two locations on South Fork Mill Creek upstream and downstream of the confluence with the tributary. Two composite samples will be collected at each location, one from pool habitat and one from riffle habitat. Each composite sample will consist of three subsamples from different pool or riffle habitats within the stream reach. Collection of macroinvertebrate samples from specific pool habitats is necessitated by the potential of tails mobilizing into the streams and settling in areas of slower moving water.

Macroinvertebrate samples will be collected using a D-ring kick net. Sampling techniques will be in accordance with the *Benthic Macroinvertebrate Biological Monitoring Protocols for Rivers and Streams* (Plotnikoff and Wiseman 2001). Samples will be labeled (both inside and outside the container) as described in Section 4.2. Samples will be preserved in the field by 85 percent ethanol. The samples will be packaged as described in Section 4.2 and shipped to Aquatic Biology Associates, Inc. for processing. The aquatic survey, field parameters, and benthic samples will be documented on the appropriate forms provided in Attachment A.

4.2 Sample Management

The following sections describe sample management activities, including sample designation, preservation, and shipping.

4.2.1 Sample Preservation

Samples will be preserved as appropriate for the required analysis. The method of preservation is and sample holding times are summarized in Table 2. Solid media samples are preserved by chilling and maintaining at 4 °C. Aqueous samples are preserved by adding nitric acid (HNO_3) or sodium hydroxide (NaOH) depending on the analysis.

4.2.2 Sample Designation

Sample containers will be sealed at the time of collection and an adhesive label placed over the lid and threads to ensure that the sample container has not been tampered with prior to delivery to the laboratory. The sample number, date and time of sample collection, sampler's initials, and requested analysis shall be recorded on the label using an indelible ink ball-point pen.

All samples will be assigned a unique sample number that indicates the media type, sample location, sample type, and sample designation. The sample number will consist of a two-letter media code, followed by a two-letter and one-digit sample location code, a one-letter sample type, and two-digit sample designation (sequential beginning with 01). The codes are summarized below.

Media Code		Location Code		Sample Type		Sample ID		Other	
MW	Mine waste	WRX	Waste rock pile	G	Grab	01	First sample	MSD	Matrix Spike Duplicate
BS	Background soil	TIX	Tailings impoundment	C	Composite	02	Second sample	RINSATE	Equipment Rinsate
SW	Surface water	OBX	Ore bin	F	Filtered	03	Third sample		
PW	Pore water	ETX	Ephemeral tributary	U	Unfiltered				
SD	Sediment	MCX	South Fork Mill Creek						
BM	Benthics	BGX	Background						
		ADX	Adit discharge						
		PDX	Pond						
		OXX	Other						

For Example: sample MW-WR3-G-02 would be the second mine waste grab sample collected from waste rock pile 3. MS/MSD duplicates samples will be identified by appending MSD to the sample number (i.e., MW-WR3-G-02-MSD). The equipment rinsate sample will be identified simply as RINSATE.

4.2.3 Shipping

The sample containers will be placed in a cooler suitable for transportation or shipping to the analytical laboratory. Plastic bags filled with ice and sealed shall be placed in the cooler to maintain the samples at 4 °C until delivery to the laboratory. Care shall be exercised to prevent direct contact between the samples and ice.

COC forms shall be used to document and track sample possession. The samples in each cooler and the required analysis will be recorded on a COC. Care will be taken to ensure the required analysis is consistent with the sample labels. One copy of the COC will be retained by the sampler and the original will be sealed in a plastic bag and placed in the cooler with the samples. When transferring possession of the samples, the COC must be signed and dated by the sample custodian. The cooler shall be sealed with tape and custody seals placed across the cooler opening and initialed.

Arrangements have been made to leave the samples with a delivery service in Spokane for delivery to SVL Analytical (SVL) Laboratory in Kellogg, Idaho. The benthic macroinvertebrate samples will be either transported to or shipped via Federal Express to Aquatic Biology Associates, Inc. in Corvallis, Oregon. The Federal Express airbills will be retained as part of the permanent COC documentation.

4.3 Laboratory Analysis

Solid and aqueous samples will be submitted to SVL and the macroinvertebrate samples will be submitted to Aquatic Biology Associates, Inc. Table 1 summarizes the samples to be collected during the field investigation and the corresponding laboratory analyses. Table 2 summarizes the analytical methods, required sample volumes, preservatives, and holding times. An iterative process will be used to establish the list of metals to be analyzed for by laboratory analysis. Because the ore and adit discharge are expected to have the highest contaminant concentrations, these samples will be first analyzed for all metals on the Target Analyte List plus cyanide (TALM+CN). The TALM consist of aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc. Mercury and cyanide have short holding times, so they will be determined in all samples. Because the holding time for other metals is 6 months, metals analysis in all other samples will be determined by analytical results of the ore and adit discharge samples. In the remaining samples, metals analysis will be limited to the subset of metals detected in the ore and adit discharge samples. The lab will be instructed to hold and maintain all remaining sample volumes for additional analysis, if determined necessary. Selected solid grab samples will also be analyzed by the modified Sobek method for acid–base accounting (ABA). Paste pH will be measured on all solids samples.

Analysis of waters will include hardness and its associated metals for the purpose of comparing toxic metals concentrations with hardness–dependent water quality criteria. Sulfate will be determined in some aquatic samples as a tracer for evidence of acid generation. Arsenic and chromium speciation can be inferred from the reduction potential, but speciation will be determined in the laboratory for two water samples for verification.

The macroinvertebrate samples will be sorted and subsampled using a Caton type sample splitter. Large debris and inorganic sediment will be inspected for attached invertebrates and removed from the sample and placed back into the original container. A 300-count subsample will be utilized for this project. Macroinvertebrates will be identified to the lowest practical level, usually genus or species. This includes Chironomidae to genus/species and Oligochaeta to species. Macroinvertebrates will be identified using published taxonomic keys.

4.4 Decontamination Procedures

Where possible, disposable single-use sampling equipment will be used for sample collection. For non-disposable sampling equipment, a temporary decontamination area will be set up. The decontamination area will be equipped with brushes, solvents, and distilled rinse water. Sampling equipment will be decontaminated before each use by scrubbing with detergent, rinsing with a dilute HNO_3 solution (10 parts distilled water to 1 part HNO_3), and rinsing with distilled water. The equipment will be allowed to air dry before use.

4.5 Investigation-derived Waste

All decontamination fluids will be allowed to drain onto the ground surface at the site and infiltrate. Disturbances to the site and environment during the field investigation will be minimized. Upon completion of the field investigation, any trash or investigation derived waste generated during the investigation will be removed from the site and properly disposed of.

5.0 QUALITY ASSURANCE PROJECT PLAN

This section describes the data quality objectives, field QA/QC procedures, and the analytical laboratory QA/QC methods and procedures.

5.1 Data Quality Objectives

Data quality objectives (DQOs) are qualitative and quantitative statements that describe the study objectives, data to be collected and study boundary, decision rules, tolerable limits on decision errors, and sampling design. DQOs for this SI were developed using EPA's seven-step process (EPA 2000), and are presented in Table 3.

5.2 Field QA/QC

Field QA/QC consists of (1) following standard sampling procedures, (2) maintaining proper sample handling and documentation, (3) calibrating and maintaining field instruments, and (4) collecting field QA/QC samples. All sampling methods and procedures will follow standard MSE protocols, unless otherwise noted in this FOP, and all field equipment will be operated, maintained, calibrated, and standardized in accordance with the manufacturer's recommended procedures. Field QA/QC samples will be collected to evaluate the precision, accuracy, and representativeness of the field sampling effort. Field QA/QC samples will consist of one matrix spike/matrix spike duplicate pair (MS/MSD) each for solids and waters, and one equipment rinsate.

The MS/MSD duplicate pair samples combine the QA/QC objectives of a normal field duplicate and a laboratory MS/MSD sample. The MS/MSD duplicates are collected at the same time and in the same manner as the other samples. However, unlike typical field duplicates, the samples are clearly labeled as MS/MSD samples. The laboratory prepares the MS/MSD samples by adding a known concentration of a specific analyte. The corresponding analytical results measure (1) the efficiency of the analytical method for the known analyte, and (2) the consistency of the overall sampling and analytical procedures for the remaining analytes. The samples will be submitted for the analyses listed in Table 1.

The equipment rinsate sample is used to assess decontamination effectiveness and cross-contamination between samples when using non-disposable equipment. One rinsate sample will be collected during sampling by pouring distilled water over freshly decontaminated sampling equipment and collecting the rinsate directly in a laboratory-supplied, 500-mL, wide mouth, plastic bottle. The sample will be submitted for the analyses listed in Table 1.

A trip blank supplied by the laboratory will be utilized for each sampling event to provide a check of sample contamination originating from sample transport and shipping. The trip blank is not to be opened in the field.

The field QA/QC samples will be collected, handled, transported, and analyzed in the same manner as investigative samples.

5.3 Laboratory QA/QC

The analytical laboratory selected for analysis of the aqueous and solids samples is accredited by the Washington Department of Ecology (WDOE) for the contaminants of concern. The laboratory will follow EPA Level II protocol for analysis and reporting, including laboratory blanks, laboratory duplicates, and MS/MSDs. All samples will be analyzed within the required holding time for each analytical procedure. Detected concentrations between the method detection limit (MDL) and practical quantitation limit (PQL) will be noted in the analytical summaries.

The analytical results will be reviewed to ensure that all laboratory QA/QC sample results are within the acceptable limits.

6.0 REFERENCES

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Table 1. Sample Summary

Medium	Description	Number of Samples[a]	Sample ID	Laboratory Analysis[b]	Field Parameters
Unprocessed Ore	Grab samples from ore bin	2 Grab	MW-OB1-G-01	pH, TALM+CN, ABA	Description
			MW-OB1-G-02		
Waste Rock	Single grab sample from each waste rock pile	3 Grab	MW-WR1-G-01	pH, Metals+CN	
			MW-WR2-G-01		
			MW-WR3-G-01		
	Composite samples from waste rock piles	2 Composite	MW-WRX-C-01	pH, Metals+CN, ABA	
			MW-WRX-C-02		
Tailings	Single grab sample from each tailing impoundment	3 Grab	MW-TA1-G-01	pH, Metals+CN	
			MW-TA2-G-01		
			MW-TA3-G-01		
	Composite samples from tailings impoundments	2 Composite	MW-TAX-C-01	pH, Metals+CN, ABA	
			MW-TAX-C-02		
Background Soil	Single grab sample from five different locations representative of background conditions	5 Grab	BS-BG1-G-01	pH, Metals+CN	
			BS-BG1-G-02		
			BS-BG1-G-03		
			BS-BG1-G-04		
			BS-BG1-G-05		
	Composite sample of subsamples from five grab sample locations	1 Composite	BS-BGX-C-01	pH, ABA	
Sediment	Composite samples of two subsamples from pool and riffle habitats at each stream surface water sample location. Composite samples of three subsamples collected from the adit discharge and each pond	10 Composite	SD-AD1-C-01	pH, Metals+CN, TOC	Description
			SD-PD1-C-01		
			SD-PD2-C-01		
			SD-PD3-C-01		
			SD-ET1-C-01		
			SD-ET2-C-01		
			SD-ET3-C-01		
			SD-ET4-C-01		
			SD-MC1-C-01		
			SD-MC2-C-01		
Solids QA/QC	Field duplicate	1 MS/MSD	MW-MSD-G-01	pH, Metals+CN	None

Table 1. Sample Summary (continued)

Medium	Description	Number of Samples	Sample ID	Laboratory Analysis	Field Parameters
Adit Discharge	Single grab from mouth of adit	1 Grab	SW-ADI-F-01	Diss. TALM; Hard; As/Cr spec.; total Se, Cr	pH, Temp, DO, EC, ORP
			SW-AD1-U-01	Total As, Hg; CN; Sulfate	
Background Water	Ephemeral tributary upstream of site, or other suitable background location	1 Grab	SW-ET1-F-01	Diss. TALM; Hard; As/Cr spec.; total Se, Cr	pH, Temp, DO, EC, ORP
			SW-ET1-U-01	Total As, Hg; CN; Sulfate	
Stream Water	<u>Ephemeral tributary</u>: (1) downstream of confluence with adit discharge (2) downstream of site (3) immediately before SF Mill Creek <u>SF Mill Creek</u>: (1) immediately upstream of tributary (2) immediately downstream of tributary	5 Grab	SW-ET2-F-01	Diss. TALM; Hard; total Se, Cr	pH, Temp, DO, EC, ORP
			SW-ET2-U-01	Total As, Hg; CN; Sulfate	
			SW-ET3-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-ET3-U-01	Total metals[b]; CN; Sulfate	
			SW-ET4-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-ET4-U-01	Total metals[b]; CN; Sulfate	
			SW-MC1-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-MC1-U-01	Total metals[b]; CN; Sulfate	
			SW-MC2-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-MC2-U-01	Total metals[b]; CN; Sulfate	
Pond Water	Single grab sample from each pond	3 Grab	SW-PD1-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	pH, Temp, DO, EC, ORP
			SW-PD1-U-01	Total metals[b]; CN; Sulfate	
			SW-PD2-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-PD2-U-01	Total metals[b]; CN; Sulfate	
			SW-PD3-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			SW-PD3-U-01	Total metals[b]; CN; Sulfate	
Pore Water	SF Mill Creek upstream and downstream of ephemeral tributary	2 Grab	PW-MC1-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	pH, Temp, DO, EC, ORP
			PW-MC1-U-01	Total metals[b]; CN; Sulfate	
			PW-MC2-F-01	Diss. metals[b]; Hard; total[b] Se, Cr	
			PW-MC2-U-01	Total metals[b]; CN; Sulfate	
Benthic Organisms	Two composite samples from each of the two surface water sample locations on SF Mill Creek	4 Composite	BM-MC1-C-01	Taxonomy, generally to genus or species	pH, Temp, DO, EC, ORP, turbidity
			BM-MC1-C-02		
			BM-MC2-C-01		
			BM-MC2-C-02		
Water QA/QC	Field duplicate	1 MS/MSD	SW-MSD-F-01	Diss. TALM; Hard; total Se, Cr	None
			SW-MSD-U-01	Total As, Hg; CN; Sulfate	
	Equipment rinsate or field blank	1 Rinsate	SW-RINSATE-U-01	Total TALM; CN; Sulfate	

Table 1. Sample Summary (continued)

Notes:

[a]Number of samples based on limited knowledge of the site. Actual sample numbers may vary based on site conditions and features.

[b]Metals analysis for unprocessed ore and adit discharge samples will consist of the TALM (Al, Ag, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn). Metals analysis for all other samples will be limited to only those metals detected in the unprocessed ore and adit discharge samples, unless otherwise noted.

ABA = Acid Base Accounting
CN = Cyanide
Cr = Chromium
DO = Dissolved oxygen
EC = Electrical conductivity
Hg = Mercury
MS/MSD = Matrix spike/matrix spike duplicate
ORP = Oxidation reduction potential
QA/QC = Quality assurance/quality control
Se = Selenium
TALM = Target Analyte List Metals
Temp. = Temperature

Table 2. Sample Volume, Preservative, and Holding Time Summary

Medium	Laboratory Analysis	Method	Container/Volume	Preservative	Holding Time
Solids	TAL Metals	200.7, 200.2, 245.1	One 500-mL plastic bottle	None	6 months, 28 days for Hg
	Cyanide	335.4	One 500-mL plastic bottle	None	14 days
	Acid-base Accounting	Modified Sobek	One 500-mL plastic bottle	None	None
	Paste pH	Handbook 60	One 500-mL plastic bottle	None	None
	Total Organic Carbon	415.1/9060	One 500-mL plastic bottle	None	28 days
Waters	Dissolved TAL Metals[(b)]	200.7, 200.2, 245.1	One 500-mL plastic bottle	HNO_3 to pH<2	6 months
	Total Selenium, Chromium, and Mercury	200.7, 200.2, 245.1	One 500-mL plastic bottle	HNO_3 to pH<2	6 months, 28 days for Hg
	Arsenic Speciation	Subramanian	One 500-mL plastic bottle	HNO_3 to pH<2	14 days
	Chromium Speciation	Colorimetric, D1687	One 250-mL plastic bottle	2.5 mL HCL	24 hours
	Cyanide	335.4	One 500-mL plastic bottle	NaOH to pH>12	14 days
	Hardness	200.7	One 500-mL plastic bottle	HNO_3 to pH<2	6 months
	Sulfate	300.0	One 500-mL plastic bottle	None	28 days

Notes:

HCL = Hydrochloric acid
Hg = Mercury
HNO_3 = Nitric acid
ML = Milliliter
NaOH = Sodium hydroxide
TAL Metals = Target Analyte List Metals (Al, Ag, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Na, Ni, Pb, Sb, Se, Tl, V, Zn)

Table 3. Data Quality Objectives

STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
State the Problem	**Identify the Decision**	**Identify Inputs to the Decision**	**Define Study Boundaries**	**Develop Decision Rule**	**Specify Tolerable Limits on Decision Errors**	**Optimize Sampling Design**
• It is unknown whether the site poses a hazard to human and ecological receptors.	1. Has a release occurred? 2. What is the volume and extent of a potential release? 3. What are the existing and potential impacts to terrestrial and aquatic habitats? 4. What is the existing and potential risk to human and ecological receptors from exposure to contaminants at the site? 5. Do contaminant concentrations exceed applicable state and federal regulatory criteria? 6. Are there physical hazards at the site that pose a risk to the public?	• Analytical results of mine waste, background, surface water, pore water, sediment, and benthic samples. • Results of aquatic survey. • Results of the physical hazards survey. • State and federal regulatory criteria for classification of waste and assessment of potential risk.	• Mine site and associated structures and debris. • Waste rock piles, tailings impoundments, and ore bin • Adit discharge • Ponds • Ephemeral drainage • South Fork Mill Creek immediately upstream and downstream of the confluence with the ephemeral tributary • Undisturbed area surrounding the site	• If contaminant concentrations exceed regulatory criteria, then estimate risk to human and ecological receptors at the site. Otherwise, leave site as is. • If estimated risks exceed acceptable levels, then establish risk-based cleanup levels. Otherwise, leave site as is. • If physical hazards are present and pose significant risk to the public, then identify critical hazards for mitigation. Otherwise, leave site as is.	• A sufficient number of samples will be collected to minimize the risk of false positive and false negative errors. • Decision errors will also be minimized through selective sampling and professional judgment. • Field and laboratory QA/QC samples will be used to ensure that data are of known precision and accuracy.	• Sampling locations will be selected based on professional judgment and cost considerations. • An XRF will be used for field screening and to guide sampling efforts. • Sampling will be focused to identify and characterize the most likely sources of contaminants, and assess the greatest potential risks at the site.

APPENDIX A

HEALTH AND SAFETY PLAN

ATTACHMENT A

FIELD FORMS

ATTACHMENT B

MHE PRODUCTS PUSH POINT SAMPLER OPERATOR'S MANUAL